Bundesamt
für Strahlenschutz

Spotlight on EMF Research

Spotlight on “The relationship between radiofrequency-electromagnetic radiation from cell phones and brain tumor: The brain tumor incidence trends in South Korea” by J. Moon in Environmental Research (2023)

Category [radiofrequency, epidemiology]

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Competence Centre Electromagnetic Fields (KEMF)

1 Putting the paper into context by the BfS

Since mobile phones began gaining widespread use in the late 1980s, there has been debate about whether exposure to radiofrequency electromagnetic fields (RF-EMF) emitted from phones increases the risk of developing brain tumours. The studies and evidence are complex. On the one hand, there is a large number of epidemiological studies with different designs and results. On the other hand, it is not trivial to measure adequately a person's radiation exposure over a possible latency period to the development of a brain tumour, or to find a valid proxy.

2 Results and conclusions from the authors’ perspective

Moon’s [1] aim is to improve the data on this topic, to contribute to a better understanding of the issue and to formulate future research questions. The author used an ecological study design, i.e. spatiotemporally aggregated data instead of individual data on the increasing prevalence of mobile phones and the incidence of brain tumours in South Korea. The number of mobile phone subscriptions per 100 inhabitants was used as a crude measure of the increasing exposure of the population to RF-EMF due to mobile phone use. To examine the trends of benign and malignant brain neoplasms for the period 1999-2018, the average annual percentage change (AAPC) of age-standardized incidence rates was calculated. To quantify a possible relationship, the correlation coefficients between the rate of cell phone subscriptions and the age-standardized incidence rates of the ICD10 brain tumour codes were calculated, assuming either a latency period of 10 years or an immediate temporal response.

Highlighted results are the statistically significant, positive correlation coefficients ≥ 0.75 for the three sublocations of malignant brain tumours C71.0, C71.1 and C71.2 (according to the ICD10 classification of medical diagnoses), as well as correlation coefficients ≥ 0.79 for the benign brain tumour codes D32, D33 and D32.0. After a detailed discussion, Moon states that the increasing trends for malignant brain tumours of the frontal lobe (C71.1, AAPC: 1.53, 95 % CI: 1.18 - 1.89) and the temporal lobe (C71.2, AAPC: 0.63, 95 % CI: 0.44 - 0.82) are suspicious of an association with RF-EMF emitted by mobile phones. The suggested causality is motivated by the site-specificity of these neoplasms, which are located in the area of highest exposure to the electromagnetic fields emitted during phone use.

3 Comments by the BfS

The topic addressed by the author is relevant from a radiation protection point of view and remains of interest to the general public. Despite extensive research, the results on the relationship between the use of mobile phones and brain tumours are still controversially discussed and have not been finally clarified [2,3,4,5].

The author presents a short insight into the literature and its contradictory results. Moon discusses various hypotheses, discloses the limitations of his work and emphasizes the importance of accurate exposure assessment for individual RF-EMF exposure from mobile phones in different usage scenarios as a challenge for generating better evidence.

However, the present study has some weaknesses especially in interpretation of results, which significantly affects its validity and explanatory power: Moon only interprets the significant increasing trends of sublocations C71.0, C71.1 and C71.2 without taking the concurrent, significant decreasing trend of sublocation C71.9 (AAPC: -3.05, 95 % CI: -3.90 - -2.52) into account. The diagnosis code C71.9 includes all those brain tumours that are not further specified and have no documented location. The opposing trends of subcategories C71.0, C71.1 and C71.2 vs. C71.9 may, therefore, be the reason for the constant trend of code C71 which encompasses all malignant brain tumour diagnoses (AAPC: 0.68, 95 % CI: -0.21 - 1.57). The starting point of Moon's considerations – the increasing trend in the incidence rates of malignant brain tumours C71.0, C71.1 and C71.2 – could therefore be an artefact of improved tumour documentation over time by the Korean Central Cancer Registry.

Inclusion of incidence rates of sublocations C71.3 to C71.8 (C71.3 Parietal lobe, C71.4 Occipital lobe, C71.5 Cerebral ventricle, C71.6 Cerebellum, C71.7 Brain stem, C71.8 Overlapping lesion of brain) could provide more detailed information, but these are not mentioned or reported. For a better understanding of the evolution of brain tumour incidence in South Korea, additional data by sex, histological type, and stratification into age-specific rates would have been desirable. Overall, without information on the completeness of cancer registration in South Korea, it is difficult to draw conclusions from incidence trends.

This missing information can be found in the work of Choi et al. [6], published in 2021. That study also obtained brain tumour incidence trends from the cancer registry of South Korea and analysed them in relation to mobile phone subscription rates, yet came to opposite conclusions.

Choi et al. [6] assessed the development of cancer incidence in greater detail by considering sex, age groups, histology and topography according to ICD-O-3, as well as tumour grading. They compared the observed with the predicted incidence rates. The latter were estimated in reference to a baseline tumour incidence from 1999, under the assumption that mobile phone subscription rates represent the proportion of the population at increased risk for brain cancer due to RF-EMF with a 10-year latency period. The predictions factored in relative risks of either 1.0, 1.2, 1.5 or 2.0.

Like Moon, Choi et al. reveal, partly the same, converse trends in specified histologies and topographies. While total incidence of all brain cancers in Korea did not increase, the incidence of glioma, and particularly glioblastoma, showed the highest and significant increase in both sexes. The incidence of brain cancers with unspecified histology shows the opposite trend. A similar picture emerges when the brain tumours are differentiated according to their topography. While the cancer rates of brain tumours in precisely specified

sublocations of the brain – in particular the frontal lobe (C71.1), followed by the temporal lobe (C71.2) – increased, the rates of unspecified brain cancer (C71.9) decreased. The authors detected the same trends for all age groups regardless of sex. The AAPCs were statistically significant and highest among individuals older than 70 years old and, to a lesser extent, in the age group of 60-69 years.

Overall, Choi et al. [6] conclude no evidence for the association between an increase in brain cancer incidence and the increasing number of mobile phone subscribers. They regard the general increase in cancer cases among the aging population and refined diagnostic technology as probable causes for the observed trends. According to the authors, the increased trends of high-grade gliomas, specifically, are due to shifts in classification of brain cancer subtypes and grades in the updated editions of the WHO classification. De Vocht [7] in his commentary to Moon takes the same view and emphasises that improved diagnoses and coding are more plausible explanations than an exogenous factor.

In conclusion, Moon's study uses a well-established ecological design to investigate the correlation between brain tumour incidence rates and mobile phone subscription rates in South Korea over time. Due to methodological shortcomings in the interpretation of incidence rates in relation to cancer registration and coding issues, the study does not support the author's conclusion that EMF exposure by mobile phone use is related to specific brain tumour increase.

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